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09/881,684	06/18/2001	Otto Z. Zhou	032566-011	8607

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Ronald L. Grudziecki
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404

EXAMINER

LISH, PETER J

ART UNIT	PAPER NUMBER
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1754

DATE MAILED: 09/30/2003

CS

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/881,684

Applicant(s)

ZHOU, OTTO Z

Examiner

Peter J Lish

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 July 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30, 32, 34-41, 43-49 and 52-72 is/are pending in the application.
- 4a) Of the above claim(s) 65-70 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 53-62 and 72 is/are allowed.
- 6) ☒ Claim(s) 1-30, 32, 34-41, 43-49, 52, 63, 64 and 71 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

Applicant's arguments with respect to the rejections under 35 USC 112 have been fully considered and are persuasive. The rejections of claims 36-38 under 35 USC 112 have been withdrawn.

Applicant's arguments filed with respect to independent claim 1 has been fully considered but they are not persuasive. The act of "varying at least one of the electron work function, electronic density of state, and electrical conductivity of the material" is inherent to the process of filling the nanotubes with the foreign species. See complete rejection below.

Applicant's arguments with respect to claim 71 have been fully considered but they are not persuasive. See complete rejection below.

Applicant's arguments with respect to claims 9 and 16 have been fully considered but they are not persuasive. Applicant argues that the closing process of Satishkumar relies upon the nanotube ends containing carboxy and hydroxy reactive groups, which are the result of ~~process~~^{treatment} by oxidants, and therefore would only be applicable given a previous oxidation treatment. It is maintained that oxidants are utilized for both purification processes (e.g. Hiura) and opening processes (e.g. Satishkumar). Therefore, oxidants may be used either to purify or to open, as is taught by the prior art references. Neither of claims 9 and 16 limits the individual claim to exclude the use of these agents.

Applicant's arguments with respect to claim 14 has been fully considered but they are not persuasive. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so

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long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Applicant's arguments with respect to claims 53-62 have been fully considered and are persuasive. The rejection of claims 53-62 has been withdrawn.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-3, 10-11, 15, 20-21, 23, 26-28, 32, 39-41, 43-48, and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan et al (USPN 5,457,343) in view of Hiura et al (USPN 5,698,175) and further in view of Satishkumar et al. ("Novel experiments with carbon nanotubes...") and Lavin et al. (US 6,426,134).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference. It is maintained that as no difference is seen between the process of Ajayan with Satishkumar with Hiura and that of the instantly claimed invention, it is expected that the processes yield identical results, specifically nanotubes having a work function of less than 5 eV. Alternatively, Satishkumar shows nanotubes filled with various amounts of metals and further teaches that by optimization of the conditions, it would be possible to extensively fill the nanotubes with the metals by chemical means (page 4928). Therefore, controlling the amount of

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metal inserted into the nanotube is taught to be the optimization of a known process, which could have been determined through routine experimentation, and which is held to be obvious by In re Boesch, 205 USPQ 215. In support of the previously taken Official Notice that sonication be used to contact the nanotubes and acid in order to provide the opening of the nanotubes, Lavin et al. (US 6,426,134) teaches that an effective and efficient method for cutting nanotubes is prolonged sonication of the nanotubes in an oxidizing acid (column 3, lines 42-45).

Claims 4, 17-19, and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claims 1 above, and further in view of Jin et al (USPN 6,283,812).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Tanaka et al (USPN 5,951,832).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Zettl et al (USPN 6,057,637).

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The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Homyonfer et al. (USPN 6,217,843).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 9 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Gao et al. ("Electrochemical intercalation of single-walled carbon nanotubes with lithium").

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Ebbesen et al. (USPN 5,641,466).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

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Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Ebbesen et al (USPN 5,641,466) and Resasco et al (USPN 6,413,487).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Liu et al. ("Fullerene Pipes").

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 22, 24-25 and 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Green et al (USPN 6,090,363).

The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claims 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan and Hiura et al. and Satishkumar et al. as applied to claim 1 above, and further in view of Moskovits et al. (USPN 6,129,901).

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The rejection of the previous office action is maintained in its entirety and incorporated herein by reference.

Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan et al. in view of Hiura et al. in view of Satishkumar et al. as applied to claim 1 above, and further in view of Gao et al. ("Electrochemical intercalation of single-walled carbon nanotubes with lithium").

The method of opening the nanotubes, as disclosed by Ajayan, is that of etching with a gaseous reactant. Gao et al, however, teach that mechanical ball-milling increases defect density and reduces the length of SWNTs by fracturing the graphite layers. They disclose that the ball-milling may facilitate ion diffusion into the nanotubes. It is known in the art that cutting carbon nanotubes does, indeed, lead to tubes with open ends. It thus would have been obvious to one of ordinary skill at the time of invention to replace the etching process of Ajayan with the ball-milling process of Gao et al. in order to cut the tubes, thereby creating open ends.

Claims 52 and 63-64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ajayan et al. in view of Hiura et al. in view of Satishkumar et al. in view of Gao et al. as applied to claim 49 above, and further in view of Jin et al. (USPN 6,283,812).

Ajayan teaches that the nanotube is available as its structural completeness for a device possessing a high mobility of electrons (column 4, lines 31-35). Jin teaches that this device may be put to use as the cathode of various articles, including microwave amplifiers and flat panel field emission displays. Cathodes containing nanotube emitters exhibit all of the properties advantageous to electron emission (column 9, lines 38-57). It is further noted that any nanotube

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product with the enhanced properties would be useful in any field-emitting device which is well known in the art. Thus it would have been obvious to one of ordinary skill at the time of invention to apply the nanotube products of Ajayan for use in the devices disclosed by Jin.

Allowable Subject Matter

Claims 53-62 are allowed. The following is a statement of reasons for the indication of allowable subject matter: The limitation of "activating" the carbon nanotubes is interpreted as the removal of the passivation layers, as recited in the instant specification (paragraphs 0063 and 0071).

Claim 72 is allowed. The following is a statement of reasons for the indication of allowable subject matter: Prior art of reference neither teaches nor suggests closing the nanotubes with passivation layers by means of an oxygen-containing gas.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

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CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter J Lish whose telephone number is 703-308-1772. The examiner can normally be reached on 9:00-6:00 Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 703-308-3837. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-305-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

PL
September 11, 2003



STUART L. HENDRICKSON
PRIMARY EXAMINER